



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
-----------------	-------------	----------------------	---------------------	------------------

10/670,487

09/25/2003

Ji Ung Lee

132614-1

8005

41838 7590 02/02/2007
GENERAL ELECTRIC COMPANY (PCPI)
C/O FLETCHER YODER
P. O. BOX 692289
HOUSTON, TX 77269-2289

EXAMINER

ROY, SIKHA

ART UNIT

PAPER NUMBER

2879

SHORTENED STATUTORY PERIOD OF RESPONSE	MAIL DATE	DELIVERY MODE
----------------------------------------	-----------	---------------

3 MONTHS

02/02/2007

PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

If NO period for reply is specified above, the maximum statutory period will apply and will expire 6 MONTHS from the mailing date of this communication.

Office Action Summary

Application No.

10/670,487

Applicant(s)

LEE ET AL.

Examiner

Sikha Roy

Art Unit

2879

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 16 November 2006.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-105 is/are pending in the application.
- 4a) Of the above claim(s) 1-68 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 69-80, 84-100 and 103 is/are rejected.
- 7) ☒ Claim(s) 81-83, 101, 102, 104 and 105 is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|----------------------------------------------------------------------------------------|-------------------------------------------------------------------|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____ |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| Paper No(s)/Mail Date <u>10/30/06</u> . | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

The Amendment, filed on November 16, 2006 has been entered and acknowledged by the Examiner.

New claims 100-105 have been entered.

Claims 1-68 have been withdrawn. Claims 69-105 are pending in the instant application.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims 69-72, 79, 80, 84, 86, 88, 93-96, 99, 100 and 103 are rejected under 35 U.S.C. 102(b) as being anticipated by U.S. Patent 5,494,179 to Hori et al.

Regarding claim 69 Hori discloses (Fig. 8h column 11 lines 10-57) a self-aligned gated field emission device comprising a substrate 121 having a surface and predetermined thickness, a porous layer 130 having a surface and predetermined thickness disposed adjacent to the surface of the substrate, wherein the porous layer 130 defines a plurality of substantially cylindrical channels (open cylindrical channels providing porosity of the layer) each of the plurality of channels being parallel to each other and substantially perpendicular to the surface of the substrate, a plurality of

Art Unit: 2879

substantially rod-shaped structures 130 disposed within at least a portion of the substantially cylindrical channels defined by the porous layer 130 and adjacent to the surface of the substrate wherein a portion of each of the plurality of rod-shaped structures protrudes above the surface of the porous layer, a gate dielectric layer 132 having a surface and predetermined thickness disposed on the surface of the porous layer wherein the gate dielectric layer is disposed between the plurality of substantially rod-shaped structures, a conductive layer 133 (gate electrode) having a surface and a predetermined thickness disposed on the surface of the gate dielectric layer 132 wherein the conductive layer is selectively disposed between the rod-shaped structures.

Regarding claims 70 and 71 Hori discloses (column 11 line 37, claim 16) the substrate is made of silicon, a semiconductor material.

Regarding claim 72 Hori discloses (column 6 lines 64-67) the substrate comprising tungsten (W).

Regarding claim 79 Hori discloses (claim 17) the plurality of rod shaped structure produced from the metal substrate (tantalum substrate) and hence comprises a metal.

Regarding claim 80 Hori discloses the metal comprising Ta.

Regarding claim 84 Hori discloses the rod-shaped structures have diameter far less than 100 nm which includes values less than 60nm.

Regarding claim 86 Hori discloses (column 9 lines 29-31) the gate dielectric layer comprising silicon oxide layer.

Regarding claim 88 Hori discloses the gate conductive layer comprising metal.

Regarding claim 93 Hori discloses (column 15 lines 36-44) the field emission device can be used in a flat display device.

Regarding claim 94 and 99 Hori discloses all the limitations same as of claim 69 and additionally Hori discloses (column 15 lines 36-44) the gated field emission device is used in a field emission display device, an electronic system.

Regarding claim 95 and 96 Hori discloses the gated field emission device is an x-ray imaging system.

Regarding claims 100 and 103 Hori discloses (Fig. 8h) the first shape and alignment of the substantially rod-shaped structures substantially conforms to the second shape and alignment of the plurality of substantially cylindrical channels.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 73, 76, 87 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent 5,494,179 to Hori et al.

Regarding claim 73 Hori discloses the claimed invention except for the limitation of thickness of the substrate being between 1 micron and 550 micron. It has been held that where the general conditions of a claim are disclosed in the prior art, discovering

Art Unit: 2879

the optimum or workable ranges involves only routine skill in the art. *In re Aller*, 105 USPQ 233. It is noted that the thickness of the substrate is selected so that it supports the porous layer along with the rod-shaped structures. It would have been obvious to one having ordinary skill in the art at the time the invention was made to select the thickness of the substrate between 1 micron and 550 micron so that it supports the anodized porous layer along with the rod-shaped structures, since optimization of workable ranges is considered within the skill of the art.

Regarding claim 76 Hori discloses the claimed invention except for the limitation of the thickness of the porous layer between 0.5 and 5 microns. It has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art. *In re Aller*, 105 USPQ 233. It would have been obvious to one having ordinary skill in the art at the time the invention was made to select the thickness of the porous layer between 0.5 micron and 5 micron so that it supports the rod-shaped structures, since optimization of workable ranges is considered within the skill of the art.

Regarding claim 87 Hori discloses the claimed invention except for the limitation of the thickness of the gate dielectric layer between 1nm and 25 nm. It has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art. *In re Aller*, 105 USPQ 233. It would have been obvious to one having ordinary skill in the art at the time the invention was made to select the thickness of the gate dielectric layer between 1nm

Art Unit: 2879

and 25 nm so that it supports the gate conductive layer, since optimization of workable ranges is considered within the skill of the art.

Claims 74,75,77 and 78 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent 5,494,179 to Hori et al. and further in view of U.S. Patent 6,278,231 to Iwasaki et al.

Regarding claim 74 Hori discloses the porous layer comprising silicon oxide and does not exemplify it comprising anodized metal oxide.

Iwasaki in analogous art of nano-structure electron-emitting device discloses (Figs. 1,2 and 18 column 7 lines 1-17, column 19 lines 36-39) nanostructure comprising semiconductor substrate 11, a porous layer with anodized aluminum oxide film 13 defining a plurality of substantially cylindrical channels and rod-shaped nanostructures disposed within the channels. Iwasaki further teaches (column 3 lines 46-65) this configuration of nano-structures can be produced in a highly reliable fashion.

Therefore it would have been obvious to one of ordinary skill in the art at the time of invention to substitute the silicon oxide layer of Hori by anodized metal oxide layer with cylindrical channels and nanotubes disposed within the channels as taught by Iwasaki for providing an electron emitting device which can be produced in a highly reliable fashion.

Regarding claim 75 Iwasaki discloses the porous layer comprising anodized aluminum oxide.

Art Unit: 2879

Regarding claim 77 Iwasaki discloses (column 17 lines 28,29) the diameter of the plurality of substantially cylindrical channels (nano holes) is about 50 nm.

Regarding claim 78 Iwasaki discloses (column 9 lines 51-61) the length (depth) of the plurality of substantially cylindrical channels is in the range of .01micron (10nm) to 100 micron.

Claims 89, 91 and 92 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent 5,494,179 to Hori et al. and further in view of U.S. Patent 6,911,767 to Takai.

Regarding claim 89 Hori does not exemplify the metal for gate electrode layer comprising one of Nb, Pt, Al, W, Mo, Ti, Ni, and Cr.

Takai discloses (column 9 lines 58-62) the conductive layer (second metal film) comprises metal selected from titanium, chrome. The selection of known material for a known purpose is considered to be within the skill of the art. Therefore it would have been obvious to one of ordinary skill in the art to use one of the metals Nb, Pt, Al, W, Mo, Ti, Ni, and Cr for the gate conducting layer of Hori depending on the suitability of intended use.

Regarding claim 91 Takai discloses (column 9 lines 61,62) the thickness of the conductive layer (second metal film) is 200nm (0.2 micron).

Hori and Takai disclose the claimed invention except for the limitation of thickness of the gate conductive layer being between 20nm and 100 nm. It has been held that where the general conditions of a claim are disclosed in the prior art,

Art Unit: 2879

discovering the optimum or workable ranges involves only routine skill in the art. *In re Aller*, 105 USPQ 233. It would have been obvious to one having ordinary skill in the art at the time the invention was made to select the thickness of the grid between 20nm and 100 nm so that it is close proximity of the aligned rod-shaped structures, and thus provides high emission current since optimization of workable ranges is considered within the skill of the art.

Regarding claim 92 Takai discloses (column 10 lines 1-4) the distance between the plurality of rod-shaped structures (same as the distance between the fine holes through which plurality of nanotubes protrude) is 2000nm (2 micron).

Hori and Takai disclose the claimed invention except for the limitation of the rod shaped structures being separated by a distance of about 50nm and 500nm. It has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art. *In re Aller*, 105 USPQ 233. It is to be noted that the number of plurality of rod-shaped emitters and hence emission current increases as the distance between them is reduced. It would have been obvious to one having ordinary skill in the art at the time the invention was made to select the distance between 50nm and 500 nm so that there is increased number of plurality of emitters and hence increased emission current since optimization of workable ranges is considered within the skill of the art.

Art Unit: 2879

Claim 90 is rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent 5,494,179 to Hori et al. and further in view of U.S. Patent 6,504,292 to Choi et al.

Regarding claim 90 Hori does not disclose the conductive gate layer comprising semiconductor material.

Choi in same field of endeavor discloses (column 7 lines 45-47) the grid conductor formed of semiconductor materials such as silicon carbide. The selection of known material for a known purpose is considered to be within the skill of the art. It would have been obvious to use semiconductor material for the gate conductive layer because the selection of known material for a known purpose is within the skill of the art.

Claims 97 and 98 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent 5,494,179 to Hori et al. and further in view of Applicant's admitted prior art (AAPA).

Regarding claims 97 and 98 Hori does not disclose explicitly the electronic system self-aligned gated field emission device being a fluorescent lighting system.

AAPA discloses (Background of the Invention section [0003]) use of electron emission device as an electron source in a gas discharge lighting and fluorescent lighting system for providing longer life.

Therefore it would have been obvious to one of ordinary skill in the art at the time of invention to use the self-aligned gated field emission device with increased longevity

of emitter tips of Hori as an electron source in a fluorescent lighting as disclosed by AAPA for providing longer life of the lighting device.

Allowable Subject Matter

Claims 81-83 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

The following is a statement of reasons for the indication of allowable subject matter:

Regarding claims 81-83, U.S. Patent 6,504,292 to Choi et al. discloses the use of dielectric material for the substantially rod-shaped structure. But there is no motivation to combine Choi with the cylindrical silicon emitters of Hori. Thus the prior art of record does not render obvious the rod-shaped structures comprising dielectric material.

Claims 82,83 would be allowable because of their dependency status from claim 81.

Claims 101,102,104 and 105 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

The following is a statement of reasons for the indication of allowable subject matter:

Art Unit: 2879

Regarding claims 101 and 104 the prior art of record does not disclose a self-aligned gated field emission device having all the limitations as claimed and particularly a plurality of substantially rod-shaped structures filling the plurality of substantially cylindrical channels and in contact with the porous layer except for the portion that protrudes above the surface of the porous layer.

Regarding claims 102 and 105 the prior art of record does not disclose or render obvious a self-aligned gated field emission device having all the combinations and particularly having the rod-shaped structures comprising material different from that of the substrate.

Response to Arguments

Applicant's arguments with respect to claims 69 and 94 have been considered but are not persuasive.

Regarding claims 69 and 94, in response to applicant's argument that cited reference of Hori fails to teach or suggest a porous layer having a surface and predetermined thickness disposed adjacent to the substrate and the porous layer defining a plurality of substantially cylindrical channels the examiner respectfully disagrees. It is noted that the oxide layer 130 of Fig. 8(h) of Hori disposed adjacent to the substrate 121 has plurality of cylindrical channels, providing pores and hence is considered as porous layer. The porous layer 130 formed by oxidation of the outer portion of the substrate is a layer adjacent to the substrate. Furthermore the examiner submits that Fig. 8(h) of Hori does disclose the plurality of rod shaped structures are

Art Unit: 2879

disposed within a portion of the substantially cylindrical channels defined by the porous layer 130 wherein a portion of the rod-shaped structures protrude above the porous layer. The applicant alleges that because the rod-shaped structures of Hori are formed by etching off the oxide layer, Hori fails to teach the claimed feature. The examiner disagrees and notes that the method of forming the rod-shaped structures of Hori is different but the device structure (self-aligned gated field-emission device) having the same limitations as claimed and there being no structural difference between the claimed invention and that disclosed by Hori the claims 69 and 94 are properly rejected.

Conclusion

THIS ACTION IS MADE FINAL. Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Art Unit: 2879

Contact Information

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Sikha Roy whose telephone number is (571) 272-2463. The examiner can normally be reached on Monday-Friday 8:00 a.m. – 4:30 p.m.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nimeshkumar D. Patel can be reached on (571) 272-2457. The fax phone number for the organization is (571) 273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Sikha Roy

Sikha Roy
Patent Examiner
Art Unit 2879